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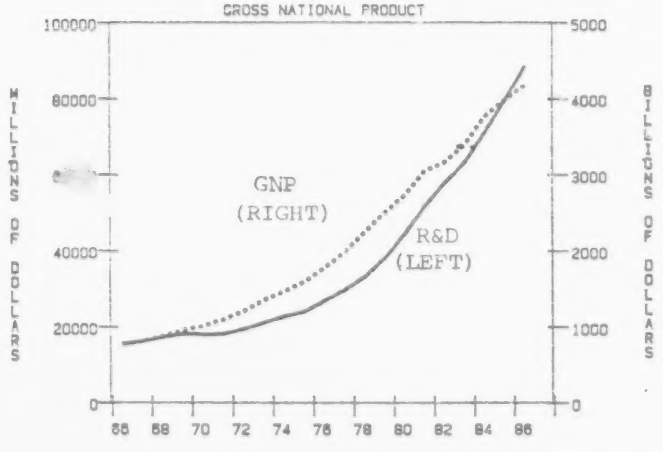
31st ANNUAL MCGRAW-HILL SURVEY OF RESEARCH AND DEVELOPMENT EXPENDITURES, 1985-1988

Research and development (R&D) expenditures by U.S. industry are expected to continue rising at a torrid pace in 1986 despite grim expectations for capital spending, falling corporate profits, and an overall economy that is far from robust (Chart 1). According to McGraw-Hill's latest survey, R&D spending by business is projected to boom 10.9% in 1986 to $88.4 billion (Table I). In contrast, businesses are projecting a 0.5% cut in outlays for plant and equipment this year. And U.S. gross national product will probably grow at only half the rate of R&D.

All figures cited above include inflation. If the ambitious plans for 1986 research and development materialize, "real" R&D spending would jump about 8.5%--the largest annual gain in over two decades (Chart 2). What's more, on the heels of 1984 and 1985--years when real R&D spending boomed over

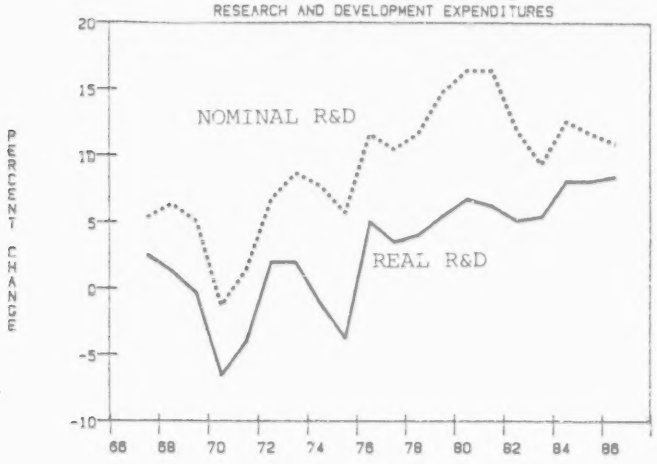
CHART 1
RESEARCH AND DEVELOPMENT SPENDING
VERSUS
GROSS NATIONAL PRODUCT



8% annually--1986 will cap off the hottest spending streak since the late 1950s.

These are some of the key findings of the "31st Annual McGraw-Hill Survey of Research and Development Expenditures." The results, tabulated in March and April, were drawn from over 400 companies that responded to an overall capital spending survey. Dollar figures have been adjusted to represent all U.S. business.

CHART 2
GROWTH IN REAL VERSUS NOMINAL
RESEARCH AND DEVELOPMENT EXPENDITURES

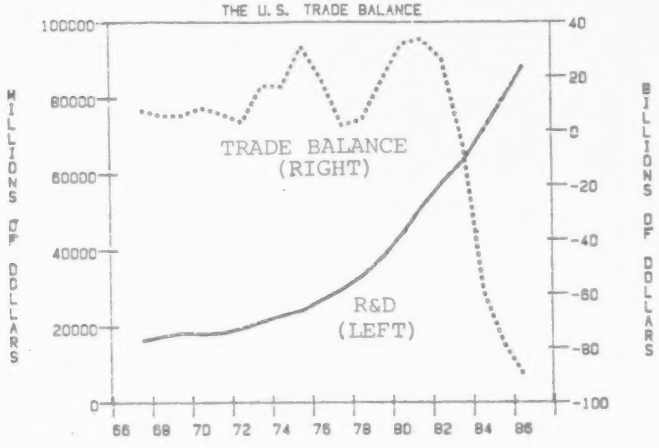


U.S. Business' Growing Emphasis on R&D

Since the late seventies, when U.S. trade tipped into deep deficit, industry has shaken off the doldrums in its R&D spending to prepare for battle in an increasingly competitive business atmosphere (Chart 3). Consider this: From 1953 through 1963, real R&D spending by U.S. business skyrocketed at an average annual rate of 10.8%. However, from 1964 through 1978, U.S. industry slammed the brakes on spending: real growth inched along at an annual rate of just 0.8%. Then from 1979 through 1985, R&D spending heated up considerably

to an annual rate of 6.5%. While growth of late has been much more moderate than three decades ago, it is still blistering compared to the preceding era. And in the current post-recessionary period of 1983 through 1986, R&D spending

CHART 3
RESEARCH AND DEVELOPMENT EXPENDITURES
VERSUS
THE U.S. TRADE BALANCE



has gained even more steam, rising at an average annual rate of 8.2%.

But are the ingredients there to spur another long-term string of magnificent growth rates for research and development spending? If increased foreign competition has any bearing on what U.S. industry spends to develop better products and techniques (and Chart 3 suggests that it does), then prospects look good for R&D.

According to the survey, R&D spending by U.S. business will advance a total of 12.1% from 1986 through 1988--about 3% real growth annually. But while the survey's current-year projections are usually quite accurate, the longer-term ones often undershoot the mark. The probable reason is that funds for R&D budgets several years out are not yet firmed up at the time the surveys are taken. Given this tendency to undershoot the more distant future, current projections for 1988 appear healthy. What's more, there is clearly much impetus at present for U.S. firms to soup up their R&D spending in the next couple of years.

The Import Invasion: With Beefed Up R&D, American Industry Fights Back

The U.S. trade balance debacle provides the greatest carrot for American firms to light a fire under R&D spending. For example, from 1982 through 1985, U.S. net exports tumbled from a surplus of $26.4 billion to a record deficit of $78.5 billion. In merchandise trade alone, a deficit of $31.7 billion in 1982 grew to a $132.8 billion by 1985. Even the most sophisticated high-tech industries like electronics fell from a net export to a net import position. And import penetration in such labor-intensive businesses as textiles grew from bad to unbearable. Hence the motive for beefed-up spending on research and development. For example, in 1977, R&D spending by electrical machinery and textile firms accounted for 6.7% and 0.2% of respective industry shipments. In 1985, R&D expenditures were up to 9.4% of electrical machinery industry sales and 0.3% of textile industry sales.

Currently, the ungainly U.S. exchange rate that crippled U.S. exports and inundated domestic markets with imports is down over 17% from a year ago. But imports are still at record highs; and even when the trade balance comes into line with the new lower exchange rate, foreign firms will want to retain a strong foothold in the world's most fertile market. In addition, much international competition now comes from East Asian nations whose currencies are tied to the U.S. dollar. Hence the decline in the U.S. currency will not help American companies vying against companies from states such as Korea, Hong Kong, and Taiwan.

U.S. Industry Starts Looking Toward the Long Term

Other indications that prospects are good for continued vigor in R&D spending abound. For one thing, it appears that U.S. business has become much more forward looking in their R&D plans. In the 1976-1979 recovery/expansion, as industry shipments soared, industry basked in the increased flow of profits without bolstering research and development. As a result, manufacturers' research and development spending as a percent of sales fell from 2.26% in 1975 to 2.11% in 1978--the lowest percentage on record (Table VII). Conversely, in the 1983-1985 recovery/expansion, U.S. businesses took advantage of their improved fortunes and for the first time on record boosted R&D expenditures to over 3% of industry shipments (Chart 4). In fact, from 3% in 1984, research and development expenditures as a percent of sales grew to nearly 3.3% in 1985. And if 1986 plans pan out, expenditures will top 3.5% of industry shipments--considerably above record levels.

Another indication that prospects for strong R&D growth in the future are bright is the constantly improving relationship between capital spending and

CHART 4
RESEARCH AND DEVELOPMENT EXPENDITURES
AS A PERCENT OF INDUSTRY SHIPMENTS

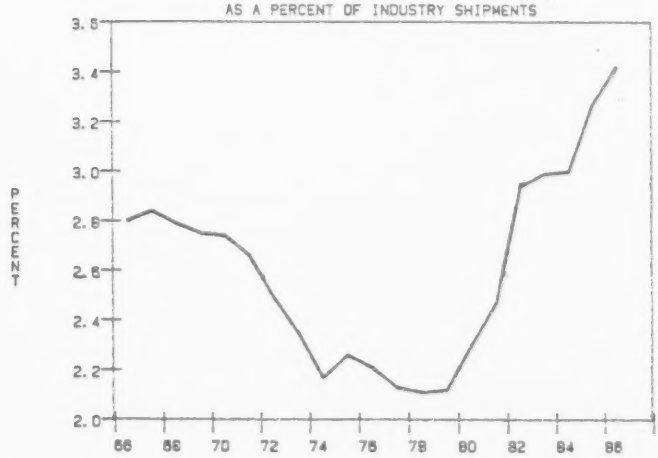
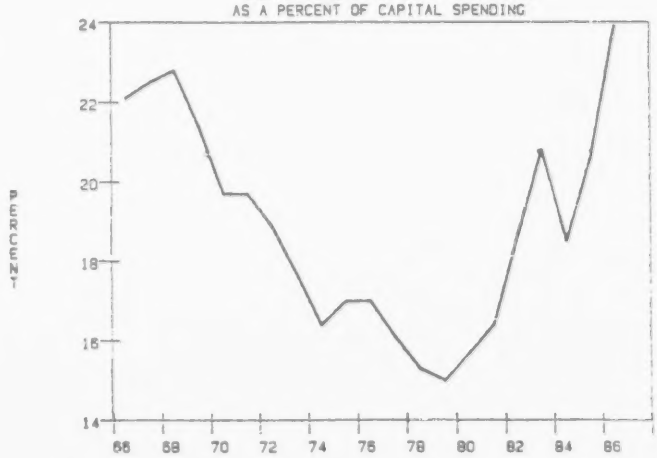


CHART 5
RESEARCH AND DEVELOPMENT SPENDING
AS A PERCENT OF CAPITAL SPENDING



research and development expenditures (Chart 5). In 1986, the stress on R&D over capital spending as the key to industry growth will continue (Table III). In contrast, from 1968 through 1979 R&D spending took a back seat to capital spending, accounting for a smaller and smaller share year after year. As a percent of capital spending, R&D expenditures fell from 22.8% in 1968 to 15% in 1979. Starting in 1980, corporate America apparently decided that expansion and modernization were more effective and profitable when coupled with better production techniques and products. From 1980 through 1985, research and development expenditures as a percent of capital spending rose from 15.7% to 20.6%. And the 1986 percentage may well climb to 23%--the highest share in 21 years.

One development that could reduce growth in R&D outlays, however, is a cutback in U.S. government funds that finance private company research on military projects. (Funds provided by the government but spent by private companies are included in this report.) Such spending shows up most in aerospace. In fact, excluding aerospace, R&D spending in 1986 is projected to rise only 5.7%. If Congressional efforts to reduce military spending succeed, it could thus have some impact on R&D spending in the private sector.

R&D Spending--Sector By Sector

Although growth in R&D spending by nonmanufacturing firms is projected to outpace R&D by manufacturing companies over the next few years, manufacturing is much more important to suppliers of R&D equipment and services since it accounts for over 96% of all R&D in private industry. By the same token, a group of six industries--all concentrating in high-tech--warrant greater attention, since they accounted for 85% of research and development spending

in 1985.

The largest and fastest growing R&D spender is the aerospace industry, which spent a whopping $18.4 billion on R&D in 1985. With lucrative military, NASA, and airline contracts at stake, spending is projected to boom more than 28% in 1986 to $23.7 billion. Electrical machinery firms, spending $17.4 billion on R&D in 1985, came in a close second to aerospace. Projected 1986 growth in that industry is expected to be a less vigorous, but healthy 11.7%, with most of the spending growth occurring in the communications equipment and electronic components sectors (Table II). Meanwhile, making $10.5 billion worth of R&D expenditures in 1985, non-electrical machinery firms were also among the big R&D spenders. But with declines expected in R&D spending by farm and construction equipment firms, special machinery manufacturers, and computer makers, the overall non-electrical machinery sector will probably cut R&D spending about 5% in 1986.

With big bucks going into specialty chemical, industrial chemical, and pharmaceutical research and development, the chemical industry is expected to boost R&D spending 5.6% to $9.5 billion in 1986. This rate of increase, however, is half 1985's rate. Automakers also plan to cut the rate of R&D spending increases in 1986. After growing at an average annual rate of over 14% from 1982 through 1985, car manufacturers intend to boost their R&D spending only 6.3% in 1986 to $8 billion. On the cutting bandwagon, too, are instrument producers who plan to reduce R&D spending growth from 12.2% in 1985 to only 3% in 1986.

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NOTE: The other manufacturing category in the tables includes lumber, wood products and furniture, tobacco, printing and publishing, leather, jewelry, toys, and transportation equipment other than autos, trucks nd parts and aerospace. The nonmanufacturing category includes mining, construction, electric and gas utilities, commercial enterprises and transportation.

SOURCES: National Science Foundation, McGraw-Hill Economics Department

TABLE I

RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of Dollars)

INDUSTRY	1984 ESTIMATED	1985 ESTIMATED	PLANNED		% CHANGE	
			1986	1988	1985-86	1986-88
Iron & Steel	620	671	642	672	-4.3	4.7
Nonferrous Metals	473	578	625	728	8.1	16.4
Electrical Machinery	15,400	17,440	19,476	23,202	11.7	19.1
Non-Electrical Machinery	9,671	10,468	9,962	10,346	-4.8	3.9
Autos,Trucks & Parts	6,380	7,544	8,021	8,924	6.3	11.3
Aerospace	16,076	18,447	23,682	26,374	28.4	11.4
Fabricated Metals	756	725	739	785	1.9	6.3
Instruments	4,910	5,483	5,649	6,273	3.0	11.1
Stone,Clay & Glass	560	655	682	709	4.0	4.1
Chemicals	8,024	8,999	9,503	10,859	5.6	14.3
Paper & Pulp	782	744	702	751	-5.7	7.0
Rubber & Plastic	1,120	1,130	1,134	1,143	0.3	0.8
Petroleum	2,200	1,908	2,163	2,261	13.4	4.5
Food & Beverage	833	901	952	1,020	5.7	7.2
Textiles	144	158	167	183	5.9	9.6
Other Manufacturing	806	856	945	1,091	10.4	15.4
ALL MANUFACTURING	68,755	76,709	85,045	95,323	10.9	12.1
ALL NONMANUFACTURING	2,633	3,016	3,400	3,803	12.8	11.8
ALL BUSINESS	71,388	79,725	88,445	99,126	10.9	12.1

TABLE II

DETAILED INDUSTRY TREND DATA

	RESEARCH AND DEVELOPMENT Spending Plans-% Change		
	1984-85	1985-86	1986-88
Furniture	8.8	9.3	18.2
Lumber	12.2	13.1	27.0
Printing and Publishing	0.0	0.0	0.8
Electric Utilities	15.6	21.8	13.4
Gas Utilities	4.2	-1.7	3.6
Electrical Industrial Apparatus	2.0	5.9	11.7
Household Appliances	12.9	0.5	10.5
Electric Lighting and Wiring	-17.5	-6.7	4.1
Radio and Television	3.3	NC	NC
Communication Equipment	30.5	13.5	22.0
Electronic Components	36.6	22.4	18.9
Other Electric Equipment	9.5	7.7	11.4
Farm Equipment	23.0	-2.0	-4.8
Construction, Mining, Materials Handling Eq.	8.8	-5.4	5.6
Metalworking Machinery	-2.3	7.5	25.1
Special Industry Machinery	15.2	-8.5	11.0
General Industrial Machinery	11.4	8.5	19.6
Office, Computing Machinery	8.1	-6.8	5.0
Refrigeration and Service Industry Machinery	-5.6	2.1	10.0
Engineering Instruments	12.9	3.2	16.4
Medical Instruments	17.3	12.6	16.0
Drugs	12.0	13.6	26.4
Industrial Chemicals	8.0	9.5	4.8
Other Chemicals	9.1	8.9	14.1
Meat Products	9.2	2.1	4.3
Dairy Products	4.7	18.6	21.3
Grain Mill Products	0.0	0.0	0.0
Beverages	50.0	13.1	10.0
Miscellaneous Plastics Products	-37.5	0.0	20.0
Glass	17.1	4.0	4.1
Cement, Hydraulic	0.0	0.0	0.0
Metal Cans	-3.4	0.0	0.0
Cutlery, Hand Tools, Hardware	20.2	19.6	68.9
Plumbing and Heating Eq.	20.0	10.0	10.0
Fabricated Structural Metal	-12.0	-0.1	0.0
Screw Machine Products	-3.5	10.0	5.0

TABLE III

RESEARCH & DEVELOPMENT
AS A PERCENT OF CAPITAL SPENDING

INDUSTRY	1985	1986
Iron & Steel	16.36	15.66
Nonferrous Metals	30.76	29.63
Electrical Machinery	112.01	144.92
Non-Electrical Machinery	65.55	60.47
Autos,Trucks & Parts	52.21	53.50
Aerospace	533.16	529.27
Fabricated Metals	20.37	18.66
Instruments	147.40	142.41
Stone,Clay & Glass	19.28	20.86
Chemicals	54.70	56.48
Paper & Pulp	8.73	7.64
Rubber & Plastic	29.51	28.86
Petroleum	7.15	10.59
Food & Beverage	8.75	9.30
Textiles	8.86	9.88
Other Manufacturing	4.40	4.61
ALL MANUFACTURING	50.09	56.85
ALL NONMANUFACTURING	3.26	3.70
ALL BUSINESS	20.63	23.00

TABLE IV

RESEARCH & DEVELOPMENT
AS A PERCENT OF SALES

INDUSTRY	1985	1986
Iron & Steel	1.28	1.23
Nonferrous Metals	0.99	1.04
Electrical Machinery	9.40	9.85
Non-Electrical Machinery	4.93	4.46
Autos,Trucks & Parts	3.70	3.79
Aerospace	20.43	25.00
Fabricated Metals	0.43	0.40
Instruments	9.65	8.98
Stone,Clay & Glass	1.14	1.13
Chemicals	4.20	4.11
Paper & Pulp	0.76	0.66
Rubber & Plastic	2.34	2.23
Petroleum	0.98	1.19
Food & Beverage	0.30	0.30
Textiles	0.30	0.30
Other Manufacturing	0.26	0.32
ALL MANUFACTURING	3.28	3.52

TABLE V

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of dollars)

INDUSTRY	1953	1954	1955	1956	1957	1958	1959	1960
Iron & Steel	42	44	46	55	64	80	84	102
Nonferrous Metals	20	25	28	35	44	51	68	75
Non-Electrical Machinery	330	358	455	543	669	781	930	949
Electrical Machinery	817	904	983	1,516	1,804	1,969	2,329	2,532
Aerospace	829	999	1,285	2,138	2,574	2,609	3,090	3,514
Autos,Trucks & Parts	495	531	561	688	707	856	866	884
Fabricated Metals	52	55	65	116	135	162	138	145
Instruments	178	195	176	200	249	294	309	329
Stone,Clay & Glass	40	45	46	60	69	75	81	88
Lumber & Furniture	10	10	10	10	14	12	12	10
Chemicals	374	407	445	641	705	792	891	980
Paper & Pulp	29	33	32	36	35	42	49	56
Rubber & Plastic	54	65	79	105	107	89	115	121
Petroleum	149	167	172	182	211	246	278	296
Textiles	10	12	12	12	15	26	30	38
Other Manufacturing	53	58	64	74	93	105	118	119
Food & Beverage	54	61	70	64	74	83	91	104
ALL MANUFACTURING	3,536	3,969	4,529	6,475	7,569	8,272	9,479	10,341
ALL NONMANUFACTURING	94	101	111	130	162	117	139	168
ALL BUSINESS	3,630	4,070	4,640	6,605	7,731	8,389	9,618	10,509

TABLE V (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of dollars)

INDUSTRY	1961	1962	1963	1964	1965	1966	1967
Iron & Steel	98	97	106	116	128	139	135
Nonferrous Metals	79	74	77	79	85	93	107
Non-Electrical Machinery	901	914	958	1,015	1,065	1,217	1,326
Electrical Machinery	2,483	2,639	2,866	2,972	3,200	3,626	3,867
Aerospace	3,829	4,042	4,712	5,078	5,148	5,526	5,669
Autos,Trucks & Parts	936	999	1,090	1,182	1,230	1,344	1,354
Fabricated Metals	136	146	153	148	145	154	163
Instruments	297	309	284	331	403	468	542
Stone,Clay & Glass	88	96	100	109	112	117	136
Lumber & Furniture	10	10	11	12	11	12	12
Chemicals	1,101	1,175	1,239	1,284	1,356	1,407	1,507
Paper & Pulp	59	65	69	77	94	117	128
Rubber & Plastic	138	141	156	158	162	168	182
Petroleum	299	310	317	393	397	371	371
Textiles	30	28	30	32	38	51	57
Other Manufacturing	105	65	54	65	71	77	90
Food & Beverage	125	121	130	144	157	164	183
ALL MANUFACTURING	10,714	11,230	12,354	13,193	13,801	15,051	15,826
ALL NONMANUFACTURING	194	234	276	319	384	497	559
ALL BUSINESS	10,908	11,464	12,630	13,512	14,185	15,548	16,385

TABLE V (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of dollars)

INDUSTRY	1968	1969	1970	1971	1972	1973	1974
Iron & Steel	135	136	149	144	147	163	181
Nonferrous Metals	115	121	126	128	130	145	177
Non-Electrical Machinery	1,483	1,546	1,729	1,860	2,158	2,549	2,985
Electrical Machinery	4,083	4,347	4,220	4,389	4,680	4,902	5,011
Aerospace	5,765	5,878	5,219	4,881	4,950	5,052	5,278
Autos,Trucks & Parts	1,499	1,568	1,591	1,768	2,010	2,477	2,476
Fabricated Metals	183	182	207	242	253	291	313
Instruments	663	742	744	746	838	961	1,075
Stone,Clay & Glass	142	159	167	164	183	199	217
Lumber & Furniture	20	18	52	53	64	71	84
Chemicals	1,589	1,660	1,773	1,832	1,932	2,116	2,450
Paper & Pulp	144	188	178	187	189	194	237
Rubber & Plastic	223	261	276	289	377	426	469
Petroleum	437	467	515	505	468	498	622
Textiles	58	60	58	59	61	64	69
Other Manufacturing	101	121	128	131	146	158	177
Food & Beverage	184	199	230	240	259	269	298
ALL MANUFACTURING	16,826	17,653	17,362	17,816	18,845	20,534	22,119
ALL NONMANUFACTURING	603	655	705	704	707	715	768
ALL BUSINESS	17,429	18,308	18,067	18,320	19,552	21,249	22,887

TABLE V (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of dollars)

INDUSTRY	1975	1976	1977	1978	1979	1980	1981
Iron & Steel	215	256	284	314	375	443	487
Nonferrous Metals	228	250	254	246	259	285	391
Non-Electrical Machinery	3,196	3,487	3,680	4,283	4,825	5,901	6,818
Electrical Machinery	5,105	5,636	5,886	6,507	7,824	9,175	10,329
Aerospace	5,713	6,339	7,033	7,536	8,041	9,198	11,968
Autos,Trucks & Parts	2,430	2,872	3,478	4,010	4,668	5,117	4,986
Fabricated Metals	324	358	386	384	455	550	624
Instruments	1,173	1,331	1,571	1,998	2,505	3,029	3,614
Stone,Clay & Glass	233	263	287	324	356	406	467
Lumber & Furniture	88	107	123	126	139	148	161
Chemicals	2,727	3,017	3,202	3,580	4,038	4,636	5,625
Paper & Pulp	249	313	333	387	445	495	566
Rubber & Plastic	467	502	491	493	577	656	678
Petroleum	693	767	918	1,060	1,262	1,552	1,958
Textiles	70	82	83	89	101	115	130
Other Manufacturing	205	217	243	266	288	364	461
Food & Beverage	335	355	415	472	528	620	641
ALL MANUFACTURING	23,452	26,152	28,867	32,075	36,686	42,690	49,904
ALL NONMANUFACTURING	735	845	958	1,229	1,540	1,815	1,906
ALL BUSINESS	24,187	26,997	29,825	33,304	38,226	44,505	51,810

TABLE V (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
(Millions of dollars)

INDUSTRY	1982	1983
Iron & Steel	600	669
Nonferrous Metals	400	446
Non-Electrical Machinery	7,835	8,386
Electrical Machinery	11,642	13,950
Aerospace	13,658	13,853
Autos,Trucks & Parts	4,962	5,631
Fabricated Metals	568	604
Instruments	4,019	4,444
Stone,Clay & Glass	460	500
Lumber & Furniture	162	169
Chemicals	6,659	7,293
Paper & Pulp	626	674
Rubber & Plastic	888	990
Petroleum	2,082	2,135
Textiles	129	130
Other Manufacturing	540	575
Food & Beverage	761	765
ALL MANUFACTURING	55,991	61,214
ALL NONMANUFACTURING	2,005	2,189
ALL BUSINESS	57,996	63,403

TABLE VI

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
AS A PERCENT OF CAPITAL INVESTMENT

INDUSTRY	1953	1954	1955	1956	1957	1958	1959
Iron & Steel	4.5	7.4	6.9	5.4	4.7	8.0	10.3
Nonferrous Metals	4.7	9.7	12.4	8.0	5.0	10.7	19.7
Non-Electrical Machinery	42.0	51.9	56.2	50.4	52.1	84.4	91.4
Electrical Machinery	152.7	178.1	190.0	207.0	242.1	342.4	328.0
Aerospace	552.7	689.0	564.8	574.0	556.5	931.8	1,021.5
Autos,Trucks & Parts	36.7	29.9	36.7	31.9	45.4	73.6	64.4
Fabricated Metals	11.7	12.1	12.6	18.2	19.6	30.7	22.1
Instruments	161.8	139.3	110.0	105.3	131.1	196.0	162.6
Stone,Clay & Glass	9.9	10.2	7.2	6.6	8.9	13.7	11.5
Chemicals	26.6	36.5	44.3	44.3	41.0	60.1	76.0
Paper & Pulp	7.1	7.3	6.2	4.5	4.3	7.3	7.6
Rubber & Plastic	22.3	32.1	33.3	32.1	32.2	40.0	41.4
Petroleum	5.2	5.7	5.6	5.3	5.5	9.0	10.0
Food & Beverage	5.3	6.0	7.2	5.6	6.1	7.5	7.5
ALL MANUFACTURING	28.4	33.1	36.2	39.6	43.2	63.7	68.9
ALL NONMANUFACTURING	0.5	0.6	0.6	0.6	0.7	0.6	0.6
ALL BUSINESS	12.1	14.1	15.0	17.4	19.1	24.8	26.8

TABLE VI (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
AS A PERCENT OF CAPITAL INVESTMENT

INDUSTRY	1960	1961	1962	1963	1964	1965	1966
Iron & Steel	7.6	11.4	12.7	12.0	8.1	8.1	8.1
Nonferrous Metals	23.8	26.8	21.8	16.6	14.2	11.9	9.3
Non-Electrical Machinery	78.4	80.8	72.3	77.1	63.1	47.5	41.9
Electrical Machinery	248.2	237.0	265.9	281.0	252.9	189.3	144.3
Aerospace	1,018.6	1,255.4	1,023.3	1,077.0	1,231.0	975.9	472.3
Autos,Trucks & Parts	55.6	63.5	63.2	56.3	44.3	38.3	39.0
Fabricated Metals	24.1	25.9	24.6	22.3	17.5	16.8	13.5
Instruments	137.1	129.1	118.8	97.9	114.1	80.6	65.0
Stone,Clay & Glass	11.2	12.6	13.2	14.2	13.4	13.0	10.4
Chemicals	61.7	68.7	74.2	71.8	61.1	48.1	42.0
Paper & Pulp	7.3	9.5	10.5	9.8	8.5	8.8	8.8
Rubber & Plastic	35.1	38.3	37.6	40.3	33.8	27.7	25.8
Petroleum	10.2	10.1	10.1	10.2	11.2	10.2	8.3
Food & Beverage	7.7	8.3	8.3	8.7	8.2	8.4	7.8
ALL MANUFACTURING	63.2	69.0	70.1	71.5	62.2	54.3	48.0
ALL NONMANUFACTURING	0.7	0.9	0.9	1.0	1.1	1.1	1.3
ALL BUSINESS	26.6	28.5	28.1	28.9	26.4	23.8	22.1

TABLE VI (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
AS A PERCENT OF CAPITAL INVESTMENT

INDUSTRY	1967	1968	1969	1970	1971	1972	1973	1974
Iron & Steel	7.1	6.7	7.5	9.2	11.4	13.7	13.0	9.2
Nonferrous Metals	9.7	10.4	11.4	10.7	12.6	13.4	11.9	10.0
Non-Electrical Machinery	43.8	51.0	42.6	45.7	59.0	66.8	64.5	58.2
Electrical Machinery	123.5	129.0	133.0	120.9	144.7	165.5	140.7	131.8
Aerospace	453.5	470.6	454.8	593.1	777.8	722.6	633.5	435.3
Autos,Trucks & Parts	42.4	49.6	44.6	42.2	60.7	54.0	51.6	46.0
Fabricated Metals	12.6	13.5	13.6	17.0	20.1	17.7	16.1	16.2
Instruments	75.3	90.8	81.5	85.5	93.3	96.3	83.6	90.3
Stone,Clay & Glass	14.7	15.9	14.3	15.8	17.5	13.7	12.6	13.1
Chemicals	48.9	56.6	55.1	52.5	56.0	57.2	50.8	39.6
Paper & Pulp	8.6	11.3	11.6	10.3	14.6	13.0	9.7	8.2
Rubber & Plastic	27.4	23.4	24.3	30.1	36.5	36.6	27.3	29.1
Petroleum	7.7	8.8	8.9	10.0	9.7	9.8	10.8	8.8
Food & Beverage	8.9	8.3	7.2	6.9	7.2	7.9	7.2	7.0
ALL MANUFACTURING	49.1	52.0	48.7	46.9	53.0	53.2	48.5	42.1
ALL NONMANUFACTURING	1.4	1.4	1.3	1.3	1.2	1.0	0.9	0.9
ALL BUSINESS	22.5	22.8	21.4	19.7	19.7	18.9	17.7	16.4

TABLE VI (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
AS A PERCENT OF CAPITAL INVESTMENT

INDUSTRY	1975	1976	1977	1978	1979	1980	1981	1982
Iron & Steel	7.0	8.2	9.9	12.1	11.7	12.9	14.0	15.9
Nonferrous Metals	13.3	17.7	19.6	16.9	15.7	13.4	15.5	21.1
Non-Electrical Machinery	65.8	64.3	61.1	57.7	47.5	51.7	49.8	58.3
Electrical Machinery	165.6	156.2	127.5	110.5	103.7	93.9	97.7	105.8
Aerospace	480.1	621.5	616.9	427.0	297.8	257.8	356.2	400.5
Autos,Trucks & Parts	56.9	60.3	48.5	44.3	45.1	44.8	41.3	54.2
Fabricated Metals	16.6	16.3	15.7	13.1	14.1	16.5	17.2	18.4
Instruments	110.7	117.8	116.4	125.7	142.3	132.9	157.8	171.0
Stone,Clay & Glass	14.0	13.8	12.5	10.3	8.9	10.2	13.7	15.8
Chemicals	38.3	40.9	43.5	46.1	41.2	39.9	42.9	52.6
Paper & Pulp	8.5	10.5	9.6	10.2	8.5	7.6	9.3	11.2
Rubber & Plastic	38.9	36.6	27.8	21.2	23.4	32.3	31.5	41.0
Petroleum	7.6	7.7	7.8	8.1	8.3	7.9	7.5	7.9
Food & Beverage	7.6	6.6	7.3	7.2	7.3	7.6	6.8	8.7
ALL MANUFACTURING	43.7	44.7	42.8	40.8	38.2	38.0	39.4	46.4
ALL NONMANUFACTURING	0.8	0.8	0.8	0.9	1.0	1.1	1.0	1.1
ALL BUSINESS	17.0	17.0	16.1	15.3	15.0	15.7	16.4	18.7

TABLE VI (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
AS A PERCENT OF CAPITAL INVESTMENT

INDUSTRY	1983	1984
Iron & Steel	20.6	17.5
Nonferrous Metals	25.7	22.2
Non-Electrical Machinery	62.1	62.8
Electrical Machinery	122.1	105.4
Aerospace	475.6	449.7
Autos,Trucks & Parts	66.9	50.6
Fabricated Metals	21.5	22.0
Instruments	177.1	149.7
Stone,Clay & Glass	18.0	18.1
Chemicals	56.3	52.4
Paper & Pulp	11.4	10.8
Rubber & Plastic	40.2	36.0
Petroleum	9.2	8.6
Food & Beverage	9.8	9.4
ALL MANUFACTURING	52.7	49.5
ALL NONMANUFACTURING	1.2	1.2
ALL BUSINESS	20.8	20.1

TABLE VII

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
AS A PERCENT OF SALES

INDUSTRY	1953	1954	1955	1956	1957
Iron & Steel	NA	NA	NA	NA	NA
Nonferrous Metals	NA	NA	NA	NA	NA
Non-Electrical Machinery	1.35	1.60	1.88	1.91	2.26
Electrical Machinery	4.45	5.60	5.51	7.77	9.01
Aerospace	6.84	8.87	11.17	16.80	17.31
Autos,Trucks & Parts	1.99	2.61	2.09	2.90	2.75
Fabricated Metals	0.34	0.37	0.40	0.54	0.60
Instruments	4.74	5.45	4.53	4.68	5.40
Stone,Clay & Glass	0.56	0.62	0.53	0.67	0.81
Chemicals	1.99	2.14	2.08	2.82	3.01
Paper & Pulp	0.35	0.38	0.32	0.34	0.32
Rubber & Plastic	1.08	1.41	1.39	1.87	1.86
Petroleum	1.18	1.28	1.22	1.17	1.29
Food & Beverage	0.12	0.13	0.14	0.13	0.14
Textiles	0.08	0.10	0.09	0.09	0.10
ALL MANUFACTURING	1.26	1.49	1.57	2.06	2.31

TABLE VII (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
AS A PERCENT OF SALES

INDUSTRY	1958	1959	1960	1961	1962	1963	1964	1965
Iron & Steel	0.51	0.46	0.56	0.57	0.54	0.56	0.53	0.54
Nonferrous Metals	0.58	0.66	0.72	0.72	0.64	0.63	0.58	0.54
Non-Electrical Machinery	3.33	3.50	3.55	3.39	3.13	3.09	2.86	2.70
Electrical Machinery	10.44	10.47	10.79	9.91	9.39	9.84	9.90	9.34
Aerospace	16.90	19.46	23.56	24.49	24.90	27.95	30.32	29.39
Autos,Trucks & Parts	3.61	2.90	2.71	3.27	2.77	2.75	2.85	2.42
Fabricated Metals	0.76	0.58	0.61	0.57	0.56	0.57	0.51	0.45
Instruments	5.10	4.67	4.81	4.38	4.55	4.05	4.47	4.70
Stone,Clay & Glass	0.76	0.71	0.78	0.80	0.83	0.81	0.83	0.79
Chemicals	3.49	3.44	3.76	4.11	4.08	3.98	3.81	3.69
Paper & Pulp	0.33	0.34	0.39	0.40	0.42	0.42	0.45	0.51
Rubber & Plastic	1.27	1.43	1.49	1.70	1.58	1.62	1.54	1.41
Petroleum	1.57	1.71	1.76	1.78	1.80	1.76	2.14	2.08
Food & Beverage	0.14	0.15	0.17	0.19	0.18	0.19	0.20	0.21
Textiles	0.21	0.21	0.28	0.21	0.18	0.19	0.19	0.21
ALL MANUFACTURING	2.53	2.61	2.79	2.89	2.81	2.94	2.94	2.81

TABLE VII (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
AS A PERCENT OF SALES

INDUSTRY	1966	1967	1968	1969	1970	1971	1972	1973
Iron & Steel	0.57	0.58	0.54	0.51	0.59	0.56	0.51	0.45
Nonferrous Metals	0.49	0.60	0.60	0.55	0.57	0.62	0.54	0.49
Non-Electrical Machinery	2.59	2.69	2.91	2.76	3.06	3.33	3.27	3.28
Electrical Machinery	9.11	9.17	9.03	9.12	8.95	9.15	8.76	8.05
Aerospace	26.00	22.10	20.84	21.87	21.29	21.77	23.47	20.23
Autos,Trucks & Parts	2.64	2.89	2.68	2.68	3.17	2.66	2.74	2.90
Fabricated Metals	0.42	0.41	0.42	0.39	0.47	0.53	0.49	0.49
Instruments	4.73	4.85	5.41	5.65	5.68	5.51	5.39	5.40
Stone,Clay & Glass	0.79	0.93	0.89	0.93	0.98	0.87	0.85	0.83
Chemicals	3.52	3.64	3.54	3.50	3.66	3.59	3.37	3.25
Paper & Pulp	0.57	0.61	0.65	0.77	0.72	0.73	0.67	0.59
Rubber & Plastic	1.33	1.37	1.49	1.60	1.71	1.63	1.80	1.75
Petroleum	1.82	1.68	1.88	1.91	2.07	1.87	1.63	1.43
Food & Beverage	0.21	0.22	0.21	0.21	0.23	0.23	0.23	0.20
Textiles	0.26	0.29	0.26	0.26	0.26	0.25	0.22	0.21
ALL MANUFACTURING	2.80	2.84	2.79	2.75	2.74	2.66	2.49	2.35

TABLE VII (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
AS A PERCENT OF SALES

INDUSTRY	1974	1975	1976	1977	1978	1979	1980	1981
Iron & Steel	0.36	0.51	0.55	0.56	0.53	0.56	0.72	0.69
Nonferrous Metals	0.47	0.77	0.68	0.61	0.53	0.46	0.48	0.66
Non-Electrical Machinery	3.23	3.34	3.30	3.17	2.99	2.90	3.27	3.39
Electrical Machinery	7.61	7.95	7.63	6.66	6.48	6.74	7.14	7.37
Aerospace	19.44	19.67	20.76	21.68	20.16	16.61	15.75	18.51
Autos,Trucks & Parts	3.06	2.87	2.59	2.58	2.65	3.05	3.99	3.55
Fabricated Metals	0.47	0.47	0.46	0.43	0.38	0.40	0.47	0.50
Instruments	5.14	5.32	5.32	5.44	5.94	6.64	6.87	7.48
Stone,Clay & Glass	0.83	0.86	0.86	0.81	0.78	0.78	0.88	0.97
Chemicals	2.92	3.03	2.90	2.71	2.77	2.73	2.85	3.12
Paper & Pulp	0.57	0.60	0.65	0.64	0.68	0.68	0.68	0.71
Rubber & Plastic	1.68	1.72	1.58	1.24	1.14	1.23	1.39	1.28
Petroleum	1.06	1.00	0.93	0.94	1.02	0.85	0.78	0.87
Food & Beverage	0.18	0.19	0.20	0.22	0.22	0.22	0.24	0.24
Textiles	0.21	0.23	0.23	0.20	0.21	0.22	0.24	0.26
ALL MANUFACTURING	2.17	2.26	2.21	2.13	2.11	2.12	2.30	2.47

TABLE VII (Continued)

HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES
AS A PERCENT OF SALES

INDUSTRY	1982	1983	1984
Iron & Steel	1.27	1.38	1.15
Nonferrous Metals	0.81	0.77	0.76
Non-Electrical Machinery	4.35	4.70	4.61
Electrical Machinery	8.25	8.95	8.45
Aerospace	21.50	19.57	20.95
Autos,Trucks & Parts	3.77	3.30	3.01
Fabricated Metals	0.50	0.50	0.54
Instruments	8.58	9.28	9.18
Stone,Clay & Glass	1.05	1.02	1.02
Chemicals	3.86	3.82	3.79
Paper & Pulp	0.79	0.79	0.82
Rubber & Plastic	1.77	1.97	2.15
Petroleum	1.01	1.12	1.10
Food & Beverage	0.27	0.27	0.28
Textiles	0.27	0.25	0.26
ALL MANUFACTURING	2.94	2.99	3.02